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Intermediate Energy Nuclear Physics Group

Academic Staff

Professors	Haruhisa Miyase, Hiroaki Tsubota
Associate Professor	Kazushige Maeda
Research Physicist	Toshimi Suda
Graduate School Students	Koji Maeda(M2), Katsuaki Tomoyori(M2)
	Masami Chiba(M1), Akiko Saito(M1)

Research Activities

1. Study of electro-kaon production on hydrogen
   The ^{1}H$(e, e'K^+)$ Lambda reaction was studied as a function of the squared four-momentum transfer, $Q2$, and the virtual photon polarization, cursive-epsilon . For each of four $Q2$ settings, 0.52, 0.75, 1.00, and 2.00 $(\mathrm{GeV/c})^2$, the longitudinal and transverse virtual photon cross sections were extracted in measurements at three virtual photon polarizations. The $Q2$ dependence of the $\sigma L/\sigma T$ ratio differs significantly from current theoretical predictions. This, combined with the precision of the measurement, implies a need for revision of existing calculations.
   The 4 GeV CW electron beam operation is now routine up to several tens μA at the Thomas Jefferson National Laboratory (TJNAF). The high quality beams whose transverse emittance of less than $\sim 10^{-9}$mrad and energy spread of 2.8×10^{-5} have been provided. A lot of exciting physics has begun to investigate the quark structure of nuclei in cooperation with polarized electron beams polarized targets, and polarimeters which will play important roles in the TJNAF physics program. They will give us a new perspective on the fundamental quantities of interests in the study of electro- and photo-nuclear reactions. The three experimental halls, namely Hall-A, Hall-B, and Hall-C are almost ready for various kinds of experiments. Our collaboration at TJNAF mainly focuses on the nuclear strangeness productions. They are related to topics of high resolution hypernuclear spectroscopy and the determination of photo-kaon production amplitudes in the elementary process. The former one is tightly concerned with both the experimental and theoretical activity in Japan. The latter one is complementary to the project of photo-kaon production at SPring8 where we are preparing to use the multi-GeV polarized photon beams.
2. Study of hypernuclei by (π, K) Reaction
   We have measured lifetimes of Lambda hypernuclei over a broad mass range explicitly identifying Lambda hypernuclear production in the (π^+, K^+) reaction. The obtained results are $\tau(^{12}_{\Lambda}\mathrm{C}) = 231 \pm 15$ ps , $\tau(^{28}_{\Lambda}\mathrm{Si}) = 206 \pm 12$ ps and $\tau(_{\Lambda}\mathrm{Fe}) = 215 \pm 14$ ps.

The lifetimes of Lambda hypernuclei over the mass region from carbon to iron are found almost constant at about 80% of that of free Lambda within the statistical uncertainties. The short-range nature of the nonmesonic weak decay process, which is dominant in heavy Lambda hypernuclei, is possibly responsible for the observed weak hypernuclear mass dependence.

We have measured the polarization of ${}^{5}_{\Lambda}$He produced by the (π^+, K^+) reaction for the first time by observing the asymmetric emission of its weak decay pions. The large asymmetry parameter of the mesonic decay, which is unique to ${}^{5}_{\Lambda}$He, made the measurement possible. The measurement is consistent with the theoretical prediction by which the mechanism of the hypernuclear polarization was clarified. This technique will open a new field to the spectroscopic study of hypernuclei.

3. Study of spin-isospin excitation by means of the (γ, π) reaction
   The spin-isospin mode in nuclei is investigated by means of the (γ, π) reaction. A new type of the range telescope are fabricating for this expriment. Both the positively and negatively charged pions will be measred in coincidence with the γ-rays and nucleons in the final state at the renewaled Stretcher and Booster facility with tagged photons beams.
4. Polarized Multi-GeV photon beams at SPring8
   The GeV photon beam at SPring-8 is produced by backward-Compton scattering of laser photons from 8 GeV electrons. Polarization of the photon beam is almost 100% at the maximum energy. The obtainable energy will be 3 GeV. The photon energy is determined by a tagging of the recoil electrons. We just started the installation of beam line equipments and tagging system. A few selected experiments which can be done at the first stage of the facility developments are actively discussed.
5. Study of $(e, e'p)$ reaction on light nuclei.
   The triple differential cross sections for the ^{6}Li$(e, e'p)$ reaction have been measured in the excitation energy from 27 to 46 MeV. The cross section have no distinct structures in this energy region, and decrease smoothly with the energy transfer. The data are well reproduced by DWIA calculation assuming a direct knockout process.

Publications

1. Polarization of ${}_{\Lambda}{}^{5}$He Produced by the (π^+, K^+) Reaction Nuclear Reactions, Phys.Rev.Lett. **80**, 3471 (1998),
   S.Ajimura, M.Ishikawa, K.Ikeda, T.Kishimoto, A.Okusu, N.Shinkai, Y.Tanaka, H.Ejiri, T.Nakano, T.Nagae, H.Noumi, K.Manabe, M.Sekimoto, T.Shibata, O.Hashimoto, K.Maeda, T.Takahashi, T.Hasegawa, H.Bhang, H.Park, Y.Kim, M.Youn, T.Motoba, K.Itonaga
2. Lifetimes and Weak-Decay Modes of Λ Hypernuclei, Nucl.Phys. **A629**, 412c (1998)
   H.C.Bhang, S.Ajimura, K.Aoki, T.Hasegawa, O.Hashimoto, H.Hotchi, Y.D.Kim,

T.Kishimoto, K.Maeda, H.Noumi, Y.Ohta, K.Omata, H.Outa, H.Park, Y.Sato, M.Sekimoto, T.Shibata, T.Takahashi, M.Youn

3. Lifetimes of Λ Hypernuclei Up to $_{\Lambda}$Fe, Nucl.Phys. **A639**, 269c (1998)
H.C.Bhang, S.Ajimura, K.Aoki, T.Hasegawa, O.Hashimoto, H.Hotchi, Y.D.Kim, T.Kishimoto, K.Maeda, H.Noumi, Y.Ohta, K.Omata, H.Outa, H.Park, Y.Sato, M.Sekimoto, T.Shibata, T.Takahashi, M.Youn
4. Lifetime Measurement of $_{\Lambda}{}^{12}$C, $_{\Lambda}{}^{28}$Si, and $_{\Lambda}$Fe Hypernuclei, Phys.Rev.Lett. **81**, 4321 (1998)
H.Bhang, S.Ajimura, K.Aoki, T.Hasegawa, O.Hashimoto, H.Hotchi, Y.D.Kim, T.Kishimoto, K.Maeda, H.Noumi, Y.Ohta, K.Omata, H.Outa, H.Park, Y.Sato, M.Sekimoto, T.Shibata, T.Takahashi, M.Youn.
5. Structure of Light Λ Hypernuclei and the $\Lambda - N$ Interaction, Nucl.Phys. **A629**, 405c (1998)
O.Hashimoto, S.Ajimura, K.Aoki, H.Bhang, T.Endo, Y.Fujii, H.Hotchi, E.Hungerford, J.H.Kim, Y.D.Kim, T.Kishimoto, K.Koshino, K.Kubota, K.Maeda, T.Nagae, H.Noumi, Y.Ohta, K.Omata, H.Outa, H.Park, Y.Saito, T.Saito, Y.Sato, M.Sekimoto, T.Shibata, T.Takahashi, T.Tamagawa, H.Tamura, L.Tang, H.Tanita, M.Youn
6. New Projects at SPring-8 with Multi-GeV Polarized Photons, Nucl.Phys. **A629**, 559c (1998),
T.Nakano, H.Ejiri, M.Fujiwara, T.Hotta, K.Takanashi, H.Toki, S.Hasegawa, T.Iwata, K.Okamoto, T.Murakami, J.Tamii, K.Imai, K.Maeda, K.Maruyama, S.Date, M.M.Obuti, Y.Ohashi, H.Ohkuma, N.Kumagai
7. Longitudinal and Transverse Cross Sections in the ^{1}H$(e, e'K^+)\Lambda$ Reaction, Phys.Rev.Lett. **81**, 1805 (1998),
G.Niculescu, R.M.Mohring, P.Gueye, D.Abbott, A.Ahmidouch, Ts.A.Amatuni, P.Ambrozewicz, T.Angelescu, C.S.Armstrong, K.Assamagan, S.Avery, K.Bailey, O.K.Baker, K.Beard, S.Beedoe, E.Beise, H.Breuer, R.Carlini, J.Cha, C.C.Chang, N.Chant, E.Cisbani, G.Collins, W.Cummings, S.Danagoulian, R.De Leo, F.Duncan, J.Dunne, D.Dutta, T.Eden, R.Ent, L.Eyraud, L.Ewell, M.Finn, T.Fortune, V.Frolov, S.Frullani, C.Furget, F.Garibaldi, D.Gaskell, D.F.Geesaman, K.K.Gustafsson, J.-O.Hansen, M.Harvey, W.Hinton, E.Hungerford, M.Iodice, C.Jackson, C.Keppel, W.Kim, K.Kino, D.Koltenuk, S.Kox, L.Kramer, T.Leone, G.Lolos, A.Lung, D.Mack, R.Madey, K.Maeda, S.Majewski, P.Markowitz, C.J.Martoff, D.Meekins, A.Mihul, J.Mitchell, H.Mkrtchyan, S.Mtingwa, I.Niculescu, R.Perrino, D.Potterveld, J.W.Price, B.A.Raue, J.-S.Real, J.Reinhold, P.Roos, T.Saito, G.Savage, R.Sawafta, R.Segel, S.Stepanyan, P.Stoler, V.Tadevosian, L.Tang, L.Teodorescu, T.Terasawa, H.Tsubota, G.M.Urciuoli, J.Volmer, W.Vulcan, P.Welch, R.Williams, S.Wood, C.Yan, B.Zeidman.
8. First Experiment at RCNP on pp-Bremsstrahlung at 400 MeV, Nucl.Phys. **A629**, 213c (1998),
M.Nomachi, T.Hotta, M.Kato, M.Kawabata, Y.Maeda, N.Matsuoka, Y.Mizuno, T.Noro,

Y.Sugaya, K.Takahisa, K.Takanashi, K.Tamura, H.Toki, K.Yasuda, H.Yoshida, M.Yoshimura
Y.Yuasa, K.Imai, T.Murakami, J.Murata, I.Nakagawa, T.Tamae, H.Tsubota, H.Akiyoshi

9. π- Mesonic Weak Decay with of $^{12}_{\Lambda}$C, Nucl.Phys. **A639**, 279c (1998),
Y.Sato, O.Hashimoto, T.Takahashi, K.Maeda, H.C.Bhang, H.Park, Y.D.Kim, M.Youn, H.Outa, M.Sekimoto, T.Hasegawa, K.Omata, T.Shibata, K.Aoki, H.Noumi, T.Kishimoto, S.Ajimura
10. Measurement of the ^{6}Li$(e, e'p)$ Reaction Cross Sections at Low Momentum Transfer, Nucl.Phys. **A645**, 492 (1999),
T.Hotta, T.Tamae, T.Miura, H.Miyase, I.Nakagawa, T.Suda, M.Sugawara, T.Tadokoro, A.Takahashi, E.Tanaka, H.Tsubota.

Master Thesis (March 1998)

1. Developments of a range telescope counter for low energy π meson, Katuaki, Tomoyori (in Japanese)
2. Development of Helium drift chamber system, Koji Maeda (in Japanese)